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Published in:
Submitted papers (on CD-ROM)

Publication date:
2002

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Citation (APA):
Klinge Jacobsen, H. (2002). Regional energy consumption and income differences in Denmark. In *Submitted papers (on CD-ROM)* IAEE.

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Regional energy consumption and income differences in Denmark

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Paper submitted to the 25th IAEE conference:
"Innovation and maturity in energy markets: Experience and prospects"
June 26-29, 2002 Aberdeen, Scotland

Abstract

Internationally a debate of the distributional impact of energy taxation has focused on the tax burden relative to income. The general finding is that taxes are regressive, but with varying degree for different countries. This paper deals with price and tax impacts in a regional comparison in addition to the income perspective.

Energy consumption varies a great deal depending on the area of location of households. This study examines the relationship between location, income, heating technology characteristics and the energy tax that the households pay. The paper aims at identifying general implications of energy taxes with respect to different impact on population groups depending on localisation and income. Tax payments associated with energy use are considered relative to total disposable income of households grouped in income deciles and by other characteristics.

The importance of energy consumption and tax payments are depending on the income levels in rural areas compared to income in urban areas. In Denmark the income difference is found to be quite small, but the energy consumption and therefore also the burden of energy taxation is higher in rural areas. Furthermore the low-income households in rural areas consume much more energy than low-income households in urban areas. Low-income households in rural areas are therefore a group that is specifically exposed to increased energy taxation.

The households living in rural areas have the disadvantage of not having access to the public heating grids and the natural gas grids. Therefore they will have to rely on individual solutions which to a large extent is gas oil, electricity and biomass. Apart from higher energy costs the rural households also pays considerable higher taxes on transport by private cars. This is caused by the less developed public transport in rural areas and therefore higher car frequency in combination with the more sparse population.

This paper documents that the rural population has higher energy bills also compared to income, but there is not a higher degree of inequality in rural areas in Denmark. In countries with higher inequality in income distribution and a higher proportion of low-income households in rural areas the impact of energy and transport taxes might be more uneven. For countries with a high proportion of low-income households living in urban areas and little income inequality this issue might as in the Danish case not be a problem for the design of energy and environmental taxes.

Keywords*: Energy consumption, regional income, energy tax, distribution*

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1. INTRODUCTION

Regional differences in energy consumption of households are important for energy policy and especially for the implementation and structure of energy and environmental taxes. The issue of distributional considerations has most often been considered in relation to income groups in specific countries. The impact on different groups of households depending on the regional localisation has been considered less, but for energy consumption this difference might be quite important. Rural households have different heating options, less network availability and finally they are located more disperse resulting in higher needs for private transport.

Studies concerning environmental taxation and distributional impacts in general find that these taxes have regressive effects. The gradual increase in energy and environmental taxation has raised concern over the distributional impacts of such taxes[1]. The OECD (1994, 1995) examine distributional effects of environmental policy in a broad context including both theoretical results as well as empirical findings on distributional effects caused both by the taxation and by a reduction of environmental pressure. Empirical findings[2] for Europe by Pearson and Smith (1991) suggest that carbon taxes tend to be more regressive in northern European countries than in southern European countries. This is due partly to taxes on petrol, which tend to be more progressive in southern Europe than in northern Europe, and partly to the climate-induced necessity for heating in northern Europe. The importance of heating needs and technology again point to implications for tax impact on rural households relative to urban households.

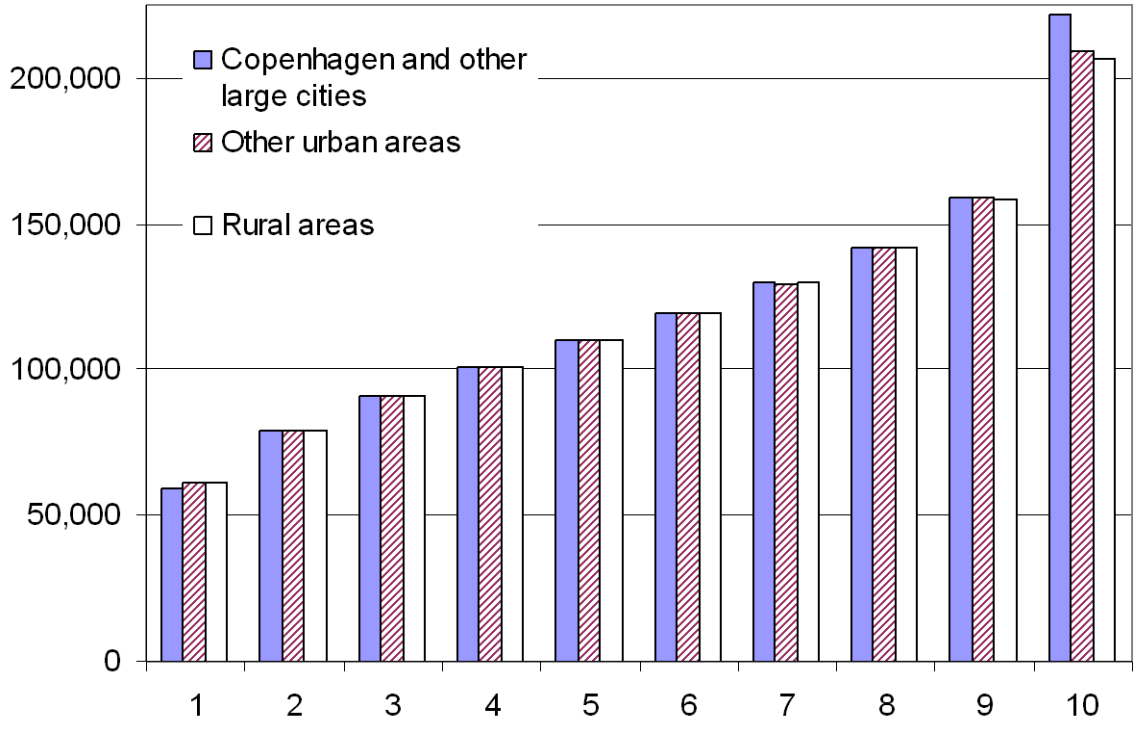

Figure 1 Disposable income per adult in income deciles 1997

[1] See Ekins (1999) for an overview of the different taxes and charges implemented in Europe.

[2] Speck (1999) includes a survey of empirical results on distributional implications of carbon and energy taxes, including most of those referred to in this paper.

Taxes related to motor vehicles are found to be neutral (Smith, 1995) in Europe on average, whereas there is evidence that petrol taxes in the US can have regressive effects, especially if considered in rural areas. This analysis therefore also considers transport-related taxes for the rural population relative to the average population.

The analysis is based on a large empirical material for energy consumption in 246.000 households in combination with corresponding socio-economic data drawn from governmental registries.

The income distribution is relatively equal in Denmark. The progressive tax system as well as relatively little variation in pre-tax incomes in combination with public transfers result in the disposable income variation in Figure 1. Average income per adult is a little less in rural areas compared to income in Copenhagen. The main observation is however that income variation is greater in the urban areas. Thus the rural population seems to be just as well off as their urban fellows, which is in contrast to what might be expected based on differences in average salaries in the two areas and an anticipated lack of modernisation and high salary jobs in rural areas.

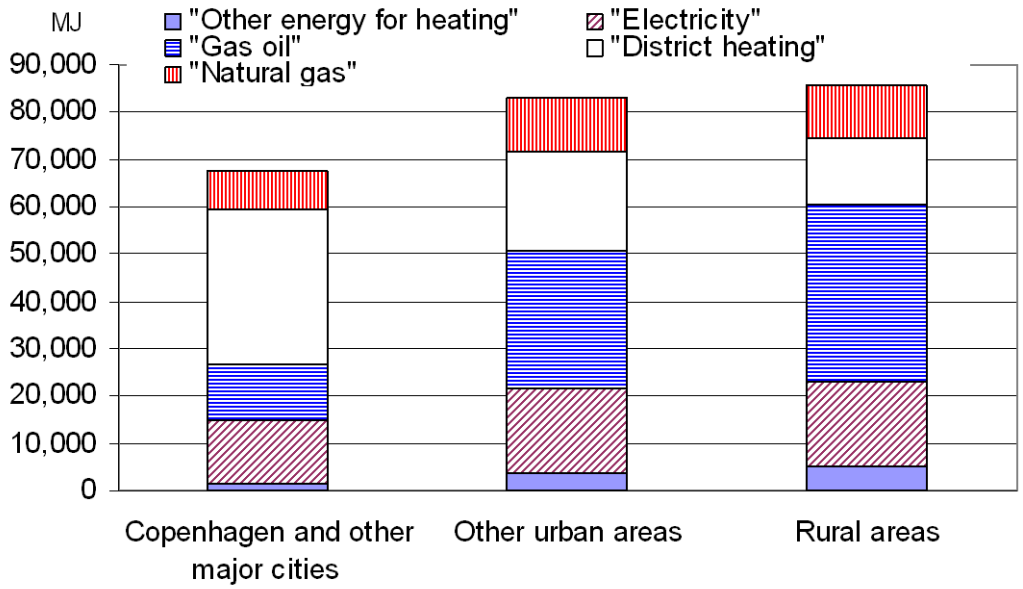

Figure 2 Consumption of electricity and energy for heating in households 1997

From the small difference in income levels seen in Figure 1 we now move to energy consumption in the regions. Figure 2 show that there is a much larger difference in energy consumption both with respect to the level and the composition on fuels/technology. Energy consumption is considerably higher in other urban areas as compared to Copenhagen and other major cities. The main explanation for this is the composition of housing. Copenhagen has a large share of apartment, with average size much smaller than houses that are dominating the type of dwelling in the two other areas. This is observed from Figure 3, that show about the same level of energy consumption for detached houses regardless of where these are placed. However, the Figure 2 also reveals that there is a difference in the composition of energy consumption. Rural areas have relatively more gas oil based heating and less district heating as compared to the two other areas. Secondly other fuels is a bit larger, representing more electric heating and more biomass (straw). The first difference is a result of less grid connection and can produce effects of current energy taxes that are less favorable to rural households.

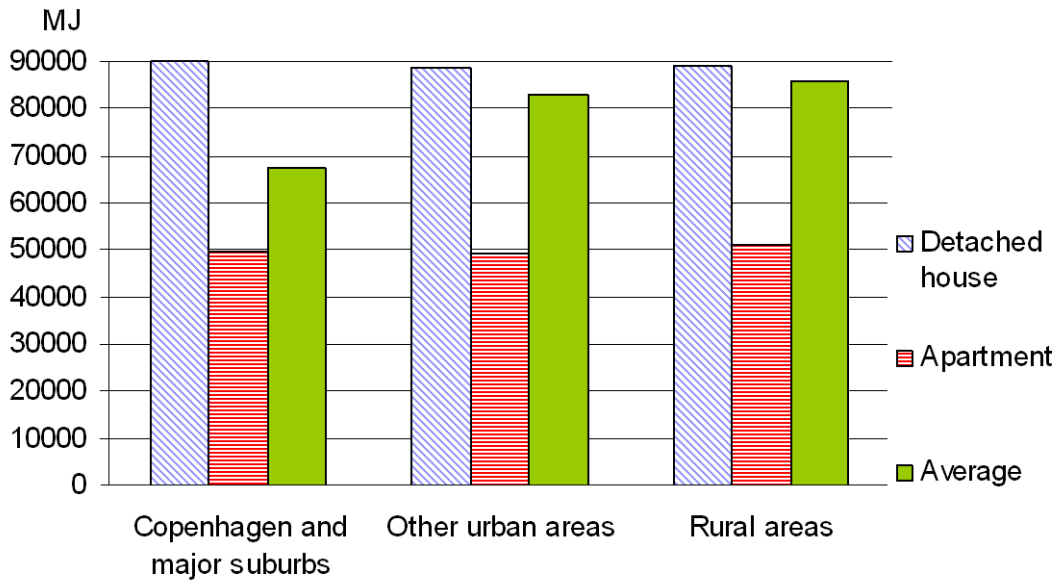

Figure 3 Energy consumption depending on urbanity and type of dwelling

The minor role of apartments in rural areas means that the average energy consumption in rural households is close to the level of consumption for households in detached houses. Rural households does not consume more energy than their urban counterparts if considered separately for each category of dwellings.

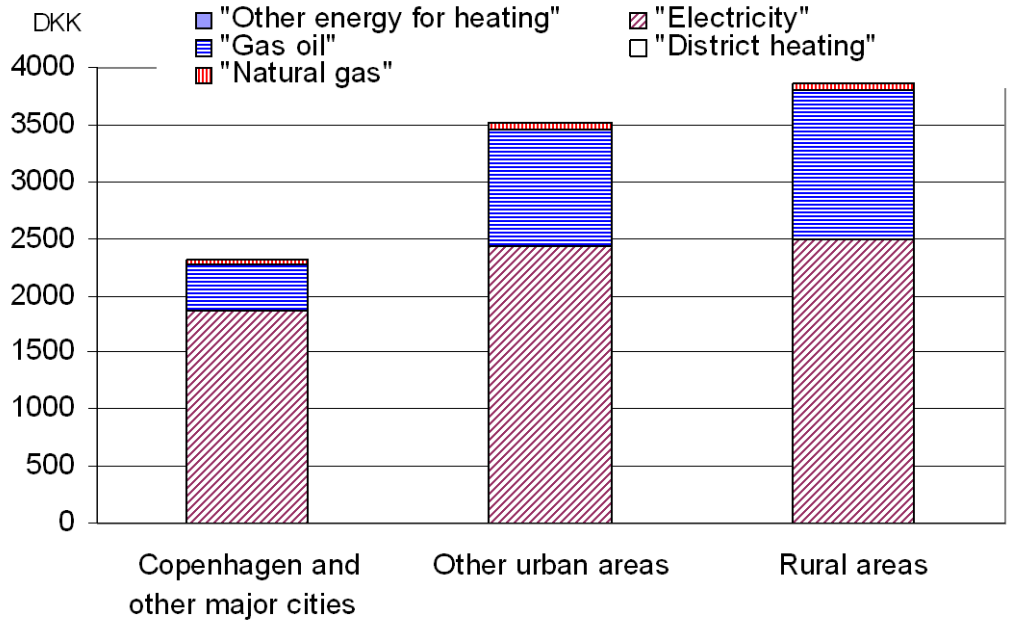

Figure 4 Energy taxation of households 1997

The energy taxation of households is calculated based on the energy consumption and tax rates for 1997 including CO2 taxes. The major part of taxes is electricity tax, which is paid by everybody. Tax on gas oil is also important even though it is only paid by a minor group.

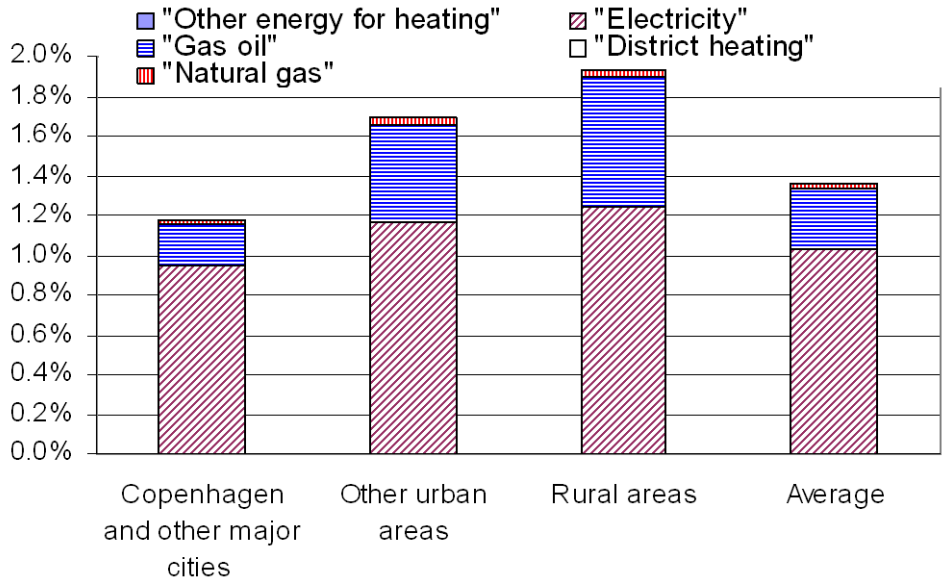

Figure 5 Energy taxes as shares of disposable income in households 1997

The tax payment is then compared to the disposable income of the households to produce a measure of the burden of taxes for the different groups of households. The higher tax payment for rural households is more pronounced if examined relative to income. Rural households use around 50% more of their income on the taxes than do the urban households.

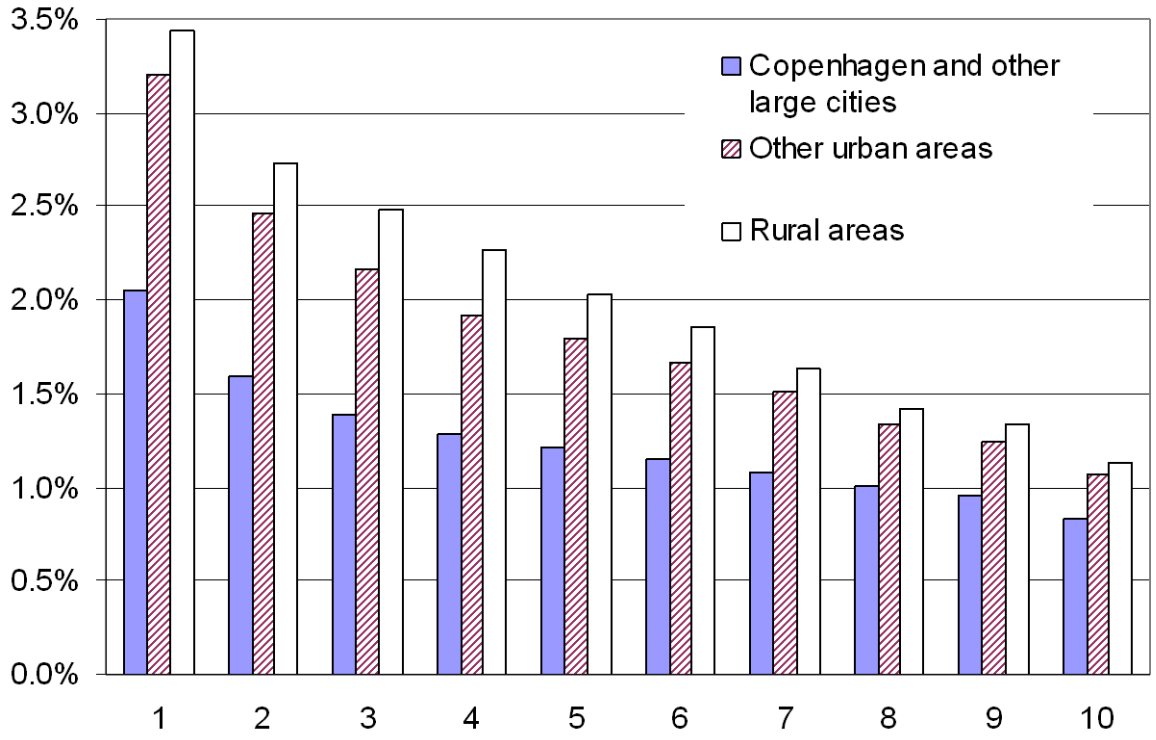

Figure 6 Energy taxes as share of disposable income for income deciles

The higher taxes paid by the rural households is also reflected if examined for all the income deciles. The property of regressivity of energy taxes is more pronounced for the rural households. The households in the first decile use close to 3.5% of their income on energy taxes whereas the same income group in urban areas use only 2% of their income on these taxes. Therefore low-income households in rural areas will be especially hurt by increased taxes. However, this group is less than 1% of the population. It might be possible that a correspondingly small group of low-income pensioners in the urban areas will be hurt just as much, but the average pensioner in urban areas or the lowest income decile on average is not hurt as much.

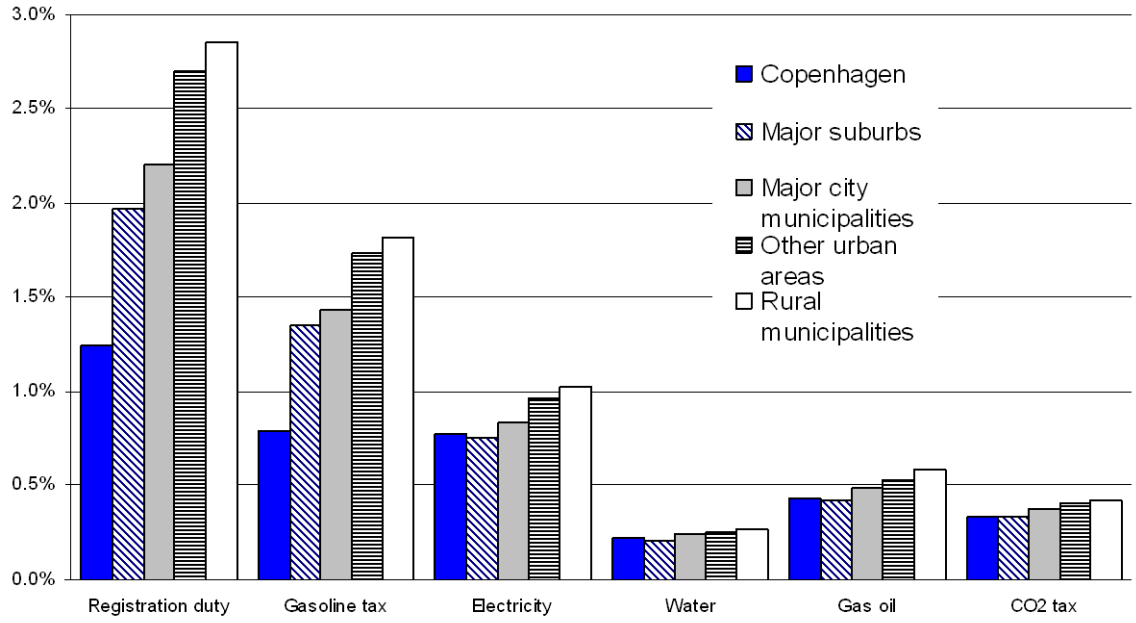

Figure 7 Residential location and selected environmental taxes

To expand the analyses other environmental taxes are examined apart from those included so far. Transport related taxes are of a considerable size and two major taxes of these are included in Figure 7, namely registration duty and gasoline tax. The figure compares the burden of taxes paid in five different regions of which the first three correspond to Copenhagen and other major city municipalities. Taxes are examined relative to disposable income for six different environmental taxes.

Rural households[3] pay a higher proportion of their income on environmental taxes than households located in cities. This goes for all taxes included in Figure 7, and the relation between residential location and tax payments also shows that the further the distance from the main cities, the larger the proportion spent on these taxes. This is especially pronounced for registration duties and petrol taxes, reflecting the facts that public transport is not available at the same scale in rural areas as it is in urban centres, and that populations in rural areas are more widely dispersed and thus depend on transport more than city dwellers. A similar explanation can be given for the more widespread use of gas oil and electric heating, as district heat and natural gas grids are less common in rural areas. The

[3] Rural households constitute 181,000 households (7.3%) of a total of 2,466,000 households in Denmark and have a disposable income per adult 5% below the average income.

general conclusion is that the impact on rural households from environmental taxes is higher than for other parts of the population.

2. CONCLUDING REMARKS

Energy consumption and the burden of energy taxes is not evenly distributed across regions and income groups. The results from this study show that households in rural areas use more energy than households in urban areas. One of the major explanations for this is that the major share of dwellings in rural areas consist of detached houses compared to a more equal share for detached houses and apartment in urban areas.

Incomes are less in rural households than in urban households, which leads to even higher shares of income spend on energy taxes for the rural households. Also the composition of energy consumption in rural households increase their relative tax payments. The much higher share of gas oil in rural households lead to energy taxes being around 1.9% of income in rural areas compared to only 1.2% in Copenhagen.

The energy taxes were also found to be regressive independent on the area of living. But also in this case the regressivity are more pronounced in rural areas were the least well of use 3.4% of income for energy taxes with the same income group in Copenhagen using only 2.1% of income for these taxes.

The main conclusion is that the tax burden for the households living in rural areas are considerably higher than for households living in urban areas.

This does not in general reflect that rural households pollute more than urban households. At least their energy consumption is in line with the energy consumption of people living in the same type of dwelling in the urban areas.

The solution is not to differentiate taxes across the country, but the difference between taxation of different fuels for heating is unfavourable to rural households and should be considered. Secondly the importance of having alternative heating technologies available and especially the importance of having transport alternatives for cars is vital for rural households possibilities for reducing the burden of these taxes.

ACKNOWLEDGEMENTS

This study was supported by the Danish Energy Research Programme, EFP-99. I gratefully acknowledge the kind assistance, including access to data provided by the Ministry for Economic Affairs and the Ministry of Finance.

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